

Psychedelics not linked to mental health problems or suicidal behavior: A population study

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Abstract

A recent large population study of 130,000 adults in the United States failed to find evidence for a link between psychedelic use (lysergic acid diethylamide, psilocybin or mescaline) and mental health problems. Using a new data set consisting of 135,095 randomly selected United States adults, including 19,299 psychedelic users, we examine the associations between psychedelic use and mental health. After adjusting for sociodemographics, other drug use and childhood depression, we found no significant associations between lifetime use of psychedelics and increased likelihood of past year serious psychological distress, mental health treatment, suicidal thoughts, suicidal plans and suicide attempt, depression and anxiety. We failed to find evidence that psychedelic use is an independent risk factor for mental health problems. Psychedelics are not known to harm the brain or other body organs or to cause addiction or compulsive use; serious adverse events involving psychedelics are extremely rare. Overall, it is difficult to see how prohibition of psychedelics can be justified as a public health measure.

Keywords

Psychedelic, hallucinogen, epidemiology, public health, suicide

Introduction

The classical psychedelics lysergic acid diethylamide (LSD), psilocybin (magic mushrooms) and mescaline (peyote and other cacti) have their primary mechanism of action at the serotonin 2A (5-HT2A) receptor, elicit similar, often indistinguishable effects and show cross-tolerance (Bonson, 2012). Over 30 million adults in the United States (US) have tried psychedelics (approximately one in six adults aged 21–64 years) (Krebs and Johansen, 2013a).

Psychedelics are not known to harm the brain or other body organs or to cause addiction or compulsive use (Halberstadt, 2015; Bonson, 2012). Psychedelics are well known for inducing profound effects on the mind, which sometimes include confusion and emotional turmoil (McWilliams and Tuttle, 1973). Both the European Monitoring Center for Drugs and Drug Addiction (EMCDDA) and the health authorities in the Netherlands, where hundreds of thousands of servings of psilocybin mushrooms are legally sold in shops each year, report that serious injuries related to psychedelics are extremely rare (EMCDDA, 2011; CAM, 2007). Furthermore, Dutch police report that legal sale of psilocybin mushrooms has not led to public order problems (Van Amsterdam et al., 2011). Approximately 0.005% of emergency department visits in the US involve LSD or psilocybin (US Department of Health and Human Services, Substance Abuse and Mental Health Services Administration, Center for Behavioral Health Statistics and Quality 2013; Centers for Disease Control and Prevention (CDC), 2014). Drug abuse experts consistently rank LSD and/or psilocybin mushrooms as much less harmful to the individual user and to society compared to alcohol and other controlled substances (Nutt et al., 2007, 2010; Taylor et al., 2012; van Amsterdam et al., 2010). Controlled studies have not linked either clinical administration or regular

use of psychedelics in religious ceremonies to lasting health problems (see Krebs and Johansen, 2013b).

Psychedelics often elicit deeply personally and spiritually meaningful experiences and sustained beneficial effects (Carhart-Harris and Nutt, 2010; Griffiths et al., 2008, 2011; Morgan et al., 2010). Common reasons for using psychedelics include mystical experiences and personal development (Hallock et al., 2005). Indeed, in many countries, including the US, select groups have protection from prosecution on grounds of freedom of belief or religion. People have used psychedelics for at least 5700 years (Bruhn et al., 2002), pre-dating the major organized religions. Modern anti-psychadelic legislation began 100 years ago when members of rival religious groups campaigned against Native American peyote use, calling peyote addictive and an ‘insidious evil’ that causes users to ‘withdraw from the churches and become “peyote worshipers”’ (Newberne and Burke, 1922). Eventually, concerned scientists defended peyote users, using evidence-based reasoning and human rights arguments (Collier, 1952; La Barre et al., 1951; Le Farge, 1960); this led to legal exemptions for specific groups. However, laws and cultural biases against peyote remained in place and were later extended to include other psychedelics. Concerns have been

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raised that the ban on use of psychedelics is a violation of the human rights to belief and spiritual practice, full development of the personality, and free time and play (United Nations General Assembly, 1948; Walsh, 2014).

There is increasing interest in the therapeutic use of psychedelics, especially for alcoholism (Krebs and Johansen, 2012), smoking cessation (Johnson et al., 2014), depression and other mental health problems (Baumeister et al., 2014; Bogenschutz, 2013; Hendricks et al., 2014). David Nutt and colleagues have explained how national and international regulations have impeded scientific research and medical treatment development with psychedelics and other highly controlled 'Schedule I' substances (Nutt et al., 2013). Prohibition has also obviously had negative consequences for the millions of individuals who find it worthwhile to use these substances in various cultural settings outside of the clinic.

Our previous population study failed to find evidence for a link between psychedelic use (lifetime use of LSD, psilocybin, mescaline, or peyote, past year use of LSD) and past year serious psychological distress, receiving or needing mental health treatment, or symptoms of eight psychiatric diagnoses, including major depression, anxiety disorders, mania and psychosis, or visual hallucinations (Krebs and Johansen, 2013b). Here, using a new large data set, which included data on suicidal thoughts and suicide attempt, we again examine the associations between the use of psychedelics and mental health.

Materials and methods

Source, population and data

The annual National Survey on Drug Use and Health (NSDUH) collects data on substance use and mental health from a random sample representative of the US civilian non-institutionalized population (<http://oas.samhsa.gov/nsduh.htm>). We pooled data from respondents aged 18 years and over from survey years 2008–2011. Half of year 2008, earlier survey years and younger respondents were not pooled due to questionnaire differences (including no questions on suicidal behavior). The response rate was 78%. In addition, approximately 10% of participants were excluded from the public use data file, either because of excessive missing data on drug use or because they were excluded at random in order to increase anonymity. The sample consisted of 135,095 respondents, of whom 19,299 (13.6% weighted) reported lifetime use of a psychedelic substance. Our previous study examined NSDUH years 2001–2004 (Krebs and Johansen, 2013b).

Use of psychedelics

We counted participants as having any lifetime psychedelic use if they reported use of LSD, psilocybin, mescaline or peyote. LSD, psilocybin and mescaline are all classical serotonergic psychedelics with main mechanism of action at the 5-HT2A receptor (Halberstadt, 2015). We combined mescaline and peyote (mescaline-containing cactus) use into one variable but also examined peyote use separately. Data on past year use was available only for LSD.

Mental health indicators

We examined 11 self-reported indicators of past year mental health problems. Past year mental health indicators also used in our previous study (Krebs and Johansen, 2013b) were serious

psychological distress during the worst month of the past year, assessed with the K6 scale (Kessler et al., 2003a), mental health treatment, including treatment for substance disorders (inpatient, outpatient, psychiatric medication prescription, felt a need for but did not receive mental health treatment). The remaining mental health indicators from our previous study, such as psychosis symptoms, were not available in this data set. Past year mental health indicators new to this study were suicide thoughts, suicide plan, suicide attempt, symptoms of major depressive episode (assessed with a questionnaire adapted from the National Comorbidity Survey (Kessler et al., 2003b), which was different from the depression questionnaire in our previous study), physician diagnosis of depression, and physician diagnosis of an anxiety disorder.

The K6 scale provides a valid assessment of general psychological distress during the worst month of the past year. It covers types of psychological distress that are common to a broad range of psychiatric disorders and has strong accuracy in discriminating between people with and without one or more diagnoses from the *Diagnostic and Statistical Manual of Mental Disorders, Fourth Edition* (American Psychiatric Association, 1994; Kessler et al., 2010).

Control variables

Control variables consisted of a variety of sociodemographic, psychological and drug use variables (Figure 1, Tables 1 and 2). The control variables were selected on the basis of associations with mental health in previous research, and were the same as those used in our previous study, with two differences: depressive episode before age 18 was now available to be included as a control variable in this study, and lifetime exposure to an extremely stressful event was not available to be included.

The control variables were age at interview (11 categories, treated as a continuous variable), gender (male, female), race/ethnicity (white, Hispanic, black, Asian, Native American, Native Hawaiian or Pacific Islander, more than one), household income (less than US\$20,000, US\$20,000–49,999, US\$50,000–74,999, US\$75,000 or more), education (not high school graduate, high school graduate, some college, college graduate), marital status (unmarried, married), likes to test self by doing risky things (never, seldom, sometimes, always), depressive episode before age 18 years (no, yes), and 10 types of lifetime drug use (cannabis/marijuana, opiates, cocaine, sedatives/tranquilizers, stimulants, MDMA/ecstasy, inhaled anesthetics, amyl nitrates, other inhalants, phencyclidine). Additionally, in the analyses of past year use of LSD we also included as control variables past year use of the other drugs listed above, but with only one variable for any past year inhalant use because data on specific inhalants were not available.

Data analysis

We used multivariate logistic regression to calculate adjusted odds ratio (aOR) associations between mental health variables and lifetime use of any psychedelics, lifetime use of the specific psychedelics (LSD, psilocybin, mescaline/peyote, peyote) and past year use of LSD. We also calculated associations between mental health and use of any psychedelics in subgroups stratified on sex, age (18–25 years, 26 or older), past year illicit drug use and depressive episode before age 18.

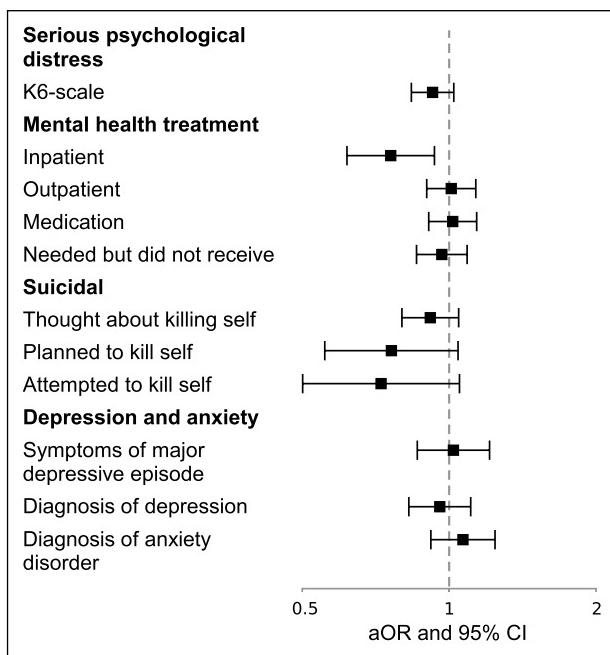


Figure 1. Association between psychedelic use and mental health. aOR: adjusted odds ratio. Values less than 1.0 indicate lower likelihood among people with lifetime psychedelic use, adjusted for age (11 categories, treated as a continuous variable), gender (male, female), race/ethnicity (white, Hispanic, black, Asian, Native American, Native Hawaiian or Pacific Islander, more than one), household income (less than US\$20,000, US\$20,000–49,999, US\$50,000–74,999, US\$75,000 or more), education (not high school graduate, high school graduate, some college, college graduate), marital status (unmarried, married), likes to test self by doing risky things (never, seldom, sometimes, always), depressive episode before age 18 years (no, yes), and 10 types of lifetime drug use (cannabis/marijuana, opiates, cocaine, sedatives/tranquilizers, stimulants, MDMA/ecstasy, inhaled anesthetics, amyl nitrates, other inhalants, phenocydine); CI: confidence interval.

All unstratified analyses had 25 or more events per control variable, and all stratified analyses had eight or more events per control variable (Vittinghoff and McCulloch, 2007). For all control variables the variance inflation factors were under 2.5, indicating little multi-collinearity.

Participants with missing data were excluded; including participants with missing values had no effect on statistical significance. All calculations accounted for the NSDUH weighting variables and complex sample design. We used SPSS/PASW Statistics (version 18.0.3).

Results

Psychedelic users were more likely than non-users to report a depressive episode before age 18. They were also more likely to be younger, male, white, unmarried, with somewhat more education and income, to like doing risky things and to have used other drugs (Tables 1 and 2).

Lifetime psychedelic use

Lifetime psychedelic use was not associated with any of the indicators of mental health problems (aOR range 0.7–1.1). Rather, lifetime psychedelic use was associated with a lower likelihood of past year inpatient mental health treatment (aOR 0.8, 95%

confidence interval (CI) 0.6–0.9, $p = 0.01$) (Figure 1, Table 3). In our previous study this association was not statistically significant (aOR 0.9, 95% CI 0.7–1.2, $p = 0.53$). Including respondents with missing data (with missing values set to the most common response) or excluding Native Americans (who may use peyote in a religious setting) did not substantially change the results.

Specific psychedelic use

Among the specific psychedelics (lifetime use of LSD, psilocybin, mescaline/peyote or peyote; past year use of LSD), we found 10 associations with a lower likelihood and one association with a greater likelihood of mental health problems (Table 4). Four of these associations were also statistically significant in our previous population study.

Associations between psilocybin use and lower likelihood of past year serious psychological distress, inpatient mental health treatment and psychiatric medication prescription were statistically significant both in this study (aOR 0.9, $p = 0.007$; aOR 0.7, $p = 0.0004$; aOR 0.8, $p = 0.002$, respectively) and in our previous study (aOR 0.8, $p = 0.009$; aOR 0.8, $p = 0.04$; aOR 0.8, $p = 0.00008$, respectively) (Krebs and Johansen, 2013b). Past year use of LSD was, with weak statistical significance, associated with lower likelihood of serious psychological distress (aOR 0.8, $p = 0.04$); this was also consistent with our previous study (aOR 0.7, $p = 0.009$).

Mescaline/peyote use was, with weak statistical significance, associated with a greater likelihood of past year symptoms of major depressive episode (aOR 1.2, $p = 0.02$); however, mescaline/peyote use was not associated with diagnosis of depression (aOR 1.0, $p = 0.59$) and peyote (mescaline-containing cactus) use was not associated with either symptoms of major depressive episode or diagnosis of depression (aOR 1.1, $p = 0.24$; aOR 0.9, $p = 0.60$, respectively). Furthermore, in our previous study, neither mescaline/peyote use nor peyote use was associated with past year symptoms of major depressive episode (aOR 0.9, $p = 0.14$; aOR 0.9, $p = 0.67$, respectively).

Stratified subgroups

In the stratified subgroups there were eight associations between psychedelic use and a decreased likelihood of various past year mental health problems, most with weak statistical significance, and none consistent with the stratified subgroups in our previous population study (Table 5). Notably, among people with a history of childhood depressive episode (before age 18 years), psychedelic use was associated with a lower likelihood of suicidal thoughts (aOR 0.8, $p = 0.01$) and suicidal plan (aOR 0.5, $p = 0.002$). Data on childhood depression and past year suicidal behavior were not available in our previous population study.

Discussion

Lack of associations with mental health or suicidality

We failed to find any associations between lifetime use of psychedelics and past year serious psychological distress, receiving or needing mental health treatment, depression, anxiety, or suicidal thoughts or behavior in the past year. Rather, lifetime use of

Table 1. Sociodemographic and psychological variables.

	Ever used psychedelics		Never used psychedelics		% used psychedelics
	wt%	N	wt%	N	wt%
Total	100%	19,299	100%	115,796	13.6%
Age					
18–25 years	13.8%	8609	14.9%	58,284	12.7%
26 years or older	86.2%	10,690	85.1%	57,512	13.7%
Sex					
Male	63.0%	11,625	45.9%	51,625	17.7%
Female	37.0%	7674	54.1%	64,171	9.7%
Race/ethnicity					
White	83.7%	15,556	65.5%	70,327	16.7%
Hispanic	8.1%	1705	14.9%	19,285	7.9%
Black	3.8%	531	12.7%	16,234	4.5%
Asian	1.3%	239	5.1%	4792	3.8%
Native American	1.0%	484	0.4%	1545	27.4%
Native Hawaiian or Pacific Islander	0.2%	46	0.4%	568	7.2%
More than one	1.9%	738	1.1%	3045	22.2%
Household income					
Less than US\$20,000	16.5%	4613	18.6%	30,113	12.3%
US\$20,000–49,999	30.1%	6638	33.3%	39,898	12.4%
US\$50,000–74,999	18.2%	3127	17.2%	18,355	14.3%
US\$75,000 or more	35.2%	4921	31.0%	27,430	15.2%
Education					
Not high school graduate	11.3%	2833	15.3%	19,407	10.4%
High school graduate	28.1%	6001	31.0%	38,256	12.5%
Some college	30.5%	6207	24.9%	33,361	16.2%
College graduate	30.0%	4258	28.8%	24,753	14.1%
Marital status					
Not married	52.5%	13,129	45.4%	74,077	15.4%
Married	47.5%	6163	54.6%	41,697	12.0%
Likes to test self by doing risky things					
Never	27.6%	4278	55.6%	53,388	7.3%
Seldom	44.7%	8258	32.4%	41,114	17.9%
Sometimes	25.0%	5871	11.0%	18,742	26.4%
Always	2.7%	871	1.1%	2266	28.3%
Depressive episode before age 18					
No	92.5%	17,067	97.1%	108,628	13.0%
Yes	7.5%	1961	2.9%	5923	29.2%

wt%: weighted percentage.

psychedelics was associated with decreased inpatient psychiatric treatment. In addition to not being significantly different from no association, in all cases the calculated aORs were small (for all, psychedelic use aOR < 1.2).

Stratifying by age, gender, past year illicit drug use or childhood depressive episode did not substantially change the results of any of the logistic regression analyses. Likewise, lifetime use of LSD, psilocybin, mescaline or peyote, or past year use of LSD was not associated with a higher rate of mental health problems.

Most claims about the harms from psychedelics have been based on theoretical assumptions and case reports, which should be evaluated with caution. See our earlier population study of mental health among psychedelic users for further discussion about case reports and previous studies (Krebs and Johansen, 2013b).

The idea of 'flashbacks' and 'hallucinogen persisting perceptual disorder'

In particular, our previous population study (Krebs and Johansen, 2013b) did not support either the idea of 'flashbacks', described in extreme cases as recurrent psychotic episodes, hallucinations, or panic attacks, or the more recent 'hallucinogen persisting perceptual disorder' (HPPD), described as persistent visual phenomena with accompanying anxiety and distress, since lifetime use of psychedelics and past year use of LSD was not associated with past year symptoms of visual phenomena ('seeing something others could not'), panic attacks, psychosis or overall serious psychological distress. Recent randomized controlled trials with psilocybin have not reported any cases of flashbacks or persistent visual phenomena (Griffiths et al., 2008, 2011; Studerus et al.,

Table 2. Lifetime illicit drug use variables.

	Ever used psychedelics		Never used psychedelics		% used psychedelics wt%
	wt%	N	wt%	N	
Total	100%	19,299	100%	115,796	13.6%
Psychedelics					
LSD	74.9%	12,806	0%	0	100%
Psilocybin	66.7%	14,438	0%	0	100%
Mescaline/peyote	33.0%	4595	0%	0	100%
Peyote	17.6%	2512	0%	0	100%
Other drugs					
Cannabis	97.8%	18,899	36.0%	48,411	29.9%
Opiates	49.7%	11,223	9.5%	15,371	45.2%
Cocaine	71.3%	13,092	7.5%	8499	60.0%
Tranquilizers and sedatives	43.5%	8688	5.6%	7446	55.1%
Stimulants	37.5%	7109	3.7%	5092	61.4%
MDMA	32.9%	8407	2.0%	4119	32.9%
Inhaled anesthetics	28.6%	5893	1.5%	2515	74.4%
Alkyl nitrites	16.0%	2401	1.1%	1155	70.1%
Other inhalants	12.3%	2524	1.7%	2931	53.3%
PCP	17.7%	2567	0.4%	404	17.7%

wt%: weighted percentage.

Table 3. Association of psychedelic use with mental health.

	Ever used psychedelics <i>N</i>	Never used psychedelics <i>N</i>	aOR ^a (95% CI)	<i>p</i>
Serious psychological distress in worst month of past year				
K6 scale	4165	15,525	0.9 (0.8–1.0)	0.12
Mental health treatment in past year				
Inpatient	694	1349	0.8 (0.6–0.9)	0.01
Outpatient	3108	8343	1.0 (0.9–1.1)	0.87
Medication	3472	11,282	1.0 (0.9–1.1)	0.77
Needed but did not receive	2534	6990	1.0 (0.9–1.1)	0.56
Suicidal thought and behavior in past year				
Thought about killing self	1748	5533	0.9 (0.8–1.0)	0.19
Planned to kill self	527	1654	0.8 (0.6–1.0)	0.09
Attempted to kill self	266	904	0.7 (0.5–1.0)	0.09
Depression and anxiety in past year				
Symptoms of major depressive episode	2446	8178	1.0 (0.9–1.2)	0.81
Diagnosis of depression	2352	7648	1.0 (0.8–1.1)	0.55
Diagnosis of an anxiety disorder	2095	5747	1.1 (0.9–1.2)	0.39

aOR: adjusted odds ratio (values less than 1.0 indicate lower likelihood); CI: confidence interval.

Bold text indicates *p* < 0.05.

^aAdjusted for age (11 categories, treated as a continuous variable), gender (male, female), race/ethnicity (white, Hispanic, black, Asian, Native American, Native Hawaiian or Pacific Islander, more than one), household income (less than US\$20,000, US\$20,000–49,999, US\$50,000–74,999, US\$75,000 or more), education (not high school graduate, high school graduate, some college, college graduate), marital status (unmarried, married), likes to test self by doing risky things (never, seldom, sometimes, always), depressive episode before age 18 years (no, yes), and 10 types of lifetime drug use (cannabis/marijuana, opiates, cocaine, sedatives/tranquilizers, stimulants, MDMA/ecstasy, inhaled anesthetics, amyl nitrites, other inhalants, phencyclidine).

2011). Interviews with over 500 regular participants in Native American peyote ceremonies did not identify anyone with flashbacks or persistent visual symptoms (Halpern et al., 2005).

Occasional visual phenomena are common in the general population, and all of the symptoms included in the purported HPPD are also present in people who have never used psychedelics. A

Table 4. Association between use of LSD, psilocybin, mescaline and peyote and mental health.

	LSD		Psilocybin		Mescaline/peyote		Peyote		LSD past year	
	aOR ^a (95% CI)	p	aOR ^a (95% CI)	p	aOR ^a (95% CI)	p	aOR ^a (95% CI)	p	aOR ^b (95% CI)	p
Serious psychological distress in worst month of past year										
K6-scale	0.9 (0.8–1.1)	0.38	0.9 (0.8–1.0)	0.007	0.9 (0.8–1.1)	0.37	0.8 (0.7–1.0)	0.05	0.8 (0.6–1.0)	0.04
Mental health treatment in past year										
Inpatient	0.8 (0.6–1.0)	0.02	0.7 (0.5–0.8)	0.0004	0.7 (0.6–0.9)	0.01	0.7 (0.5–1.0)	0.03	0.5 (0.3–0.8)	0.002
Outpatient	0.9 (0.8–1.0)	0.09	0.9 (0.8–1.1)	0.27	1.0 (0.9–1.2)	0.50	1.0 (0.8–1.2)	0.94	0.7 (0.5–0.9)	0.01
Medication	1.0 (0.9–1.2)	0.69	0.8 (0.7–0.9)	0.002	1.0 (0.9–1.1)	0.67	0.9 (0.8–1.1)	0.32	0.9 (0.6–1.2)	0.36
Needed but did not receive	0.9 (0.8–1.1)	0.21	1.0 (0.9–1.1)	0.835	1.1 (0.9–1.3)	0.28	0.9 (0.7–1.1)	0.35	0.9 (0.7–1.2)	0.59
Suicidal thought and behavior in past year										
Thought about killing self	0.9 (0.8–1.0)	0.07	1.0 (0.8–1.2)	0.95	1.0 (0.8–1.3)	0.78	0.9 (0.7–1.1)	0.31	0.9 (0.6–1.3)	0.68
Planned to kill self	0.8 (0.6–1.0)	0.06	0.9 (0.7–1.3)	0.71	1.0 (0.7–1.5)	0.79	0.7 (0.5–1.1)	0.12	1.1 (0.7–1.7)	0.80
Attempted to kill self	0.8 (0.5–1.2)	0.25	0.9 (0.6–1.3)	0.44	1.0 (0.7–1.6)	0.83	0.7 (0.4–1.2)	0.21	0.6 (0.2–1.7)	0.35
Depression and anxiety in past year										
Symptoms of major depressive episode	1.0 (0.8–1.2)	0.94	1.0 (0.8–1.2)	0.70	1.2 (1.0–1.5)	0.02	1.1 (0.9–1.4)	0.24	1.1 (0.8–1.4)	0.75
Diagnosis of depression	0.9 (0.8–1.1)	0.29	0.8 (0.7–1.0)	0.01	1.0 (0.8–1.1)	0.59	0.9 (0.8–1.2)	0.60	0.9 (0.6–1.3)	0.60
Diagnosis of an anxiety disorder	1.1 (0.9–1.3)	0.30	0.9 (0.8–1.1)	0.51	1.1 (0.9–1.4)	0.21	0.9 (0.7–1.1)	0.37	1.1 (0.7–1.5)	0.78

aOR: adjusted odds ratio (values less than 1.0 indicate lower likelihood); CI: confidence interval.

Bold text indicates $p < 0.05$.

^aAdjusted for age (11 categories, treated as a continuous variable), gender (male, female), race/ethnicity (white, Hispanic, black, Asian, Native American, Native Hawaiian or Pacific Islander, more than one), household income (less than US\$20,000, US\$20,000–49,999, US\$50,000–74,999, US\$75,000 or more), education (not high school graduate, high school graduate, some college, college graduate), marital status (unmarried, married), likes to test self by doing risky things (never, seldom, sometimes, always), depressive episode before age 18 years (no, yes), and 10 types of lifetime drug use (cannabis/marijuana, opiates, cocaine, sedatives/tranquilizers, stimulants, MDMA/ecstasy, inhaled anesthetics, amyl nitrates, other inhalants, phencyclidine).

^bAdjusted for above variables plus nine types of past year drug use (cannabis/marijuana, opiates, cocaine, sedatives/tranquilizers, stimulants, MDMA/ecstasy, inhalants, phencyclidine).

Table 5. Association of psychedelic use and mental health in stratified subgroups. Only results with $p < 0.05$ are shown.

Subgroup	Past year mental health indicator	aOR ^a (95% CI)	p
Female	Inpatient mental health treatment	0.7 (0.5–0.9)	0.01
Age 18–25	Serious psychological distress	0.9 (0.8–1.0)	0.008
Age 18–25	Psychiatric medication	0.8 (0.7–1.0)	0.03
Age 18–25	Attempted to kill self	0.7 (0.6–1.0)	0.03
Age 26 or older	Inpatient mental health treatment	0.8 (0.7–1.0)	0.04
No past year illicit drug use	Attempted to kill self	0.5 (0.2–0.9)	0.04
No depression before age 18	Inpatient mental health treatment	0.8 (0.6–0.9)	0.02
Depression before age 18	Thought about killing self	0.8 (0.6–0.9)	0.01
Depression before age 18	Planned to kill self	0.5 (0.4–0.8)	0.002

aOR: adjusted odds ratio (values less than 1.0 indicate lower likelihood); CI: confidence interval.

^aAdjusted for age (11 categories, treated as a continuous variable), gender (male, female), race/ethnicity (white, Hispanic, black, Asian, Native American, Native Hawaiian or Pacific Islander, more than one), household income (less than US\$20,000, US\$20,000–49,999, US\$50,000–74,999, US\$75,000 or more), education (not high school graduate, high school graduate, some college, college graduate), marital status (unmarried, married), likes to test self by doing risky things (never, seldom, sometimes, always), depressive episode before age 18 years (no, yes), and 10 types of lifetime drug use (cannabis/marijuana, opiates, cocaine, sedatives/tranquilizers, stimulants, MDMA/ecstasy, inhaled anesthetics, amyl nitrates, other inhalants, phencyclidine).

recent study of 120 US adults troubled by HPPD-like persistent visual symptoms found a lower than average rate of psychedelic use (Schankin et al., 2014). Overall, the validity of the HPPD

diagnosis remains scant. HPPD may fit within the somatic symptom disorders. For further discussion, see Krebs and Johansen (2013b).

Psychedelics and personally significant experiences

Our results might reflect beneficial effects of psychedelic use, relatively better initial mental health among people who use psychedelics or chance 'false positive' findings. However, it is well documented that psychedelics elicit spiritual experiences. Indeed, long-term psychological benefits have been reported in several clinical trials of LSD, for example, 'About half of the total sample felt they had achieved more understanding and acceptance of themselves and a broader tolerance of the viewpoints of others via the LSD experience' (McGlothlin and Arnold, 1971). In a recent randomized controlled trial of psilocybin, most of the participants (67%) regarded the experience as one of the most personally significant moments in their lives (comparable to the birth of a first child) (Griffiths et al., 2006) and, furthermore, most of the participants (64%) reported improved well-being or life satisfaction 14 months later (Griffiths et al., 2006, 2008; MacLean et al., 2011). People often report long-term benefits from LSD use (Morgan et al., 2010). No serious adverse events have been reported in recent randomized controlled trials of psilocybin, demonstrating that psychedelics can be administered safely in medical contexts (Griffiths et al., 2008, 2011; Johnson et al., 2008; Studerus et al., 2011). Case-control and longitudinal studies have not found evidence of increased mental health problems among people who have used traditional psychedelics (peyote or ayahuasca) hundreds of times in legally recognized religious ceremonies (Bouso et al., 2012; Halpern et al., 2005).

Limitations

This study had a retrospective, cross-sectional design, making it impossible to draw causal inferences. Many potentially important risk factors, such as family mental health history, were not available. Longitudinal data were not available on mental health or other factors before psychedelic use. We cannot exclude the possibility that use of psychedelics might have a negative effect on mental health for some individuals or groups, which might be counterbalanced at a population level by a positive effect on mental health for others. People who choose to use psychedelics might have better initial mental health before using psychedelics, and people who experience problems apparently related to psychedelics may choose to not use them again. We did not adjust for multiple comparisons, so some of the associations with weak statistical significance are likely due to chance. Screening questions, rather than diagnostic interviews, were used as symptom indicators. We did not have data on setting of use or factors that might influence the experience of psychedelics. The study also relied on self-reports of drug use. Participants' answers to the questions on behaviors and mental health could be influenced by memory errors and under-reporting; however, a 14-year longitudinal study reported good consistency over time in reporting of LSD use (Johnston and O'Malley, 1997). Use of dimethyltryptamine (DMT), found in the shamanic brew ayahuasca, could not be determined from the data set; however, recent studies of people who have used ayahuasca hundreds of times have not detected evidence of problems (Bouso et al., 2012). Dosage and purity of street drugs is often unknown and, in particular, substances sold as mescaline often contain LSD or other substances

(Laing and Siegel 2003). A small group (< 2%) of US adults in prison, hospital or military service was not included in the NSDUH sampling.

Lack of association with suicidal behavior

This study did not find any associations between psychedelic use and increased likelihood of past year suicidal thoughts, plans or attempts. Rather, among people with childhood depression, those who had used psychedelics had lower likelihood of past year suicidal thoughts and plans.

There is little evidence linking psychedelic use to later suicide. A study of 178 adolescents with psychosis reported that suicide attempt was more likely among those who had used LSD, but there was no adjustment for other factors and it was not recorded whether the suicide attempt occurred before or after LSD use (Shoval et al., 2006). A case-control study of 96 adolescents with depression reported that suicide attempt was more likely among those with hallucinogen abuse or dependence, but 'hallucinogen' was not defined and likely included drugs such as MDMA and PCP, there was little adjustment for other factors, and it was not recorded whether the suicide attempt occurred before or after hallucinogen use (Kelly et al., 2002).

In the past, some people seem to have assumed that taking psychedelics, or indeed engaging in any introspective practice, could lead to depression and suicide because of the supposedly disturbing and disappointing nature of self-knowledge (Evang, 1968); however, there now seems to be greater acceptance of introspective practices (such as 'mindfulness' or meditation) among the public and mental health professionals. In a small number of publicized cases, relatives or anti-psychadelic campaigners have blamed an individual's suicide on prior psychedelic use, without evidence of any clear connection. For instance, in 1909 a Native American peyote church member killed himself (Stewart, 1987), and his death was then cited as evidence against peyote; in the 1960s there were a few cases where relatives blamed a suicide on prior LSD use (Mikkelsen and Mikkelsen, 2005). In surveys of US, Canadian and British physicians who administered LSD to thousands of psychiatric patients in the 1950s, 1960s and 1970s, a small number of suicides and suicide attempts were reported (in people with prior suicide attempt or serious mental illness) in the year or so after taking a dose of LSD (Canada Department of National Health and Welfare, 1973; Cohen 1960; Malleson 1971; US Senate, Committee on Government Operations, Subcommittee on Executive Reorganization, 1968). Based on these and other studies, the rate of adverse events following clinical treatment with LSD was considered to be similar to that expected among psychiatric patients in general, and overall LSD was considered to have acceptable safety for clinical use (Canada Department of National Health and Welfare, 1973; Home Office, Department of Health and Social Security, 1970; US Senate, Committee on Government Operations, Subcommittee on Executive Reorganization, 1968).

When evaluating case reports of suicide in psychedelic users, it is important to note that suicide is one of the most common causes of death in the general population: approximately two out of every 100 people in the US will die by suicide (CDC, 2013). Cases of suicide or death due to other causes during the direct effects of psychedelics are extremely rare, despite the fact that millions of doses are consumed annually (EMCDDA, 2011). It is

of note that many of the stories from 50 years ago about death or injury of people while on LSD appear to be unsubstantiated urban legends (Siff, 2008).

Comments on the history of national and international control of psychedelics

Concern about psychedelic use seems to have been based on media sensationalism, lack of information and cultural biases, rather than evidence-based harm assessments. As examples of cultural biases, a 1967 case series of five university students with 'prolonged adverse reactions' to peyote consisted of a homosexual student who started a relationship with another male student, a student with pre-existing depression who wanted to travel to India and study Eastern religions, a student who left school and became a 'beatnik', a student who was prompted to seek psychotherapy for pre-existing social anxiety and paranoia about homosexuals, and an engineering student who had visions while falling asleep and eventually took a break from school to do volunteer work (Kleber, 1967). There was a common view in the early 20th century that mystical or transcendent experiences were, almost by definition, delusional and anti-scientific, and that self-exploration without the supervision of a trained therapist was dangerous (Evang, 1968; Hayman, 1964). While discussing psychedelics, psychiatrist Max Hayman wrote, 'The practices of the Christian mystics constitute one of the most tragic chapters of human history... Science is the path we have chosen to aid in man's growth and development, and mysticism in whatever guise is a contaminant of the scientific attitude' (Hayman, 1964). In an influential 1966 *Time* magazine interview, psychiatrist Sidney Cohen, one of the most prominent critics of the emerging psychedelic culture, commented on his own LSD experience: 'I got a massive jolt that I'll never forget. I got a chance to really look at myself, and I didn't like some of the things I saw' (*Time*, 1966).

The original World Health Organization (WHO) assessment of psychedelics, prepared for the 1971 Convention on Psychotropic Substances, claimed that psychedelics caused a list of problems; however, the references cited included no evidence of harm from psilocybin, mescaline or DMT, and only a small number of case reports and anecdotes of possibly LSD-related adverse effects (Isbell and Chrusciel, 1970; WHO Expert Committee on Drug Dependence, 1969). Central to the argument for international restrictions on psychedelics was the claim that psychedelics caused a special 'LSD-type' dependence, defined as 'periodic' use amongst 'arty-type' people (Eddy et al., 1965; Isbell and Chrusciel, 1970; WHO Expert Committee on Drug Dependence, 1969). Psychedelics were claimed to have 'high abuse potential' simply because there were reports of their use (Isbell and Chrusciel, 1970). The WHO report acknowledged that LSD and other psychedelics 'are usually taken in the hope of inducing a mystical experience leading to a greater understanding of the users' personal problems and of the universe' and that people diagnosed with mental disorders following psychedelic use 'are generally believed to have been persons who were "pre-disposed" to psychiatric disease' (Isbell and Chrusciel, 1970).

As noted recently by the British Medical Association (BMA), 'The cultural and social attitudes surrounding illegal drugs mean that their classification and legal status do not directly relate to the health risks they pose to users and communities' (BMA,

2012). A 1970 assessment of LSD by the UK Home Office acknowledged that use of LSD and other psychedelics was a sincere spiritual practice, noting, 'We have been content to accept the sincerity of those of our witnesses who claimed that some people have reached a greater awareness and insight into their own problems and, indeed, into the meaning of life itself, through their use of LSD'. The UK assessment explained that 'there is a presumption in favour of allowing adult men and women to consume whatever substances they please, but this presumption must be overridden in circumstances in which such freedom results in a serious danger to public health... [Evidence for which] would have to be kept under continual review in the light of rapidly developing scientific knowledge and accelerating social change' (Home Office, Department of Health and Social Security, 1970). The only epidemiological data on non-clinical use of LSD included in the UK assessment was a table showing that 127 people who were admitted to UK psychiatric hospitals in 1966–1968 had reported having tried LSD at some point, not necessarily related to the hospital visit (Home Office, Department of Health and Social Security, 1970); these cases were a surely a tiny fraction of total psychiatric admissions or total LSD users at that time. We failed to find, in this study or in our previous population study, evidence linking past year LSD use to increased likelihood of inpatient mental health treatment (Krebs and Johansen, 2013b).

A 1975 report from the US National Institute of Mental Health noted that people who use LSD 'repetitively in a social pattern' 'cannot be characterized by any specific psychiatric label' and called for more 'scientific study of hallucinogen-derived mystical experiences... described as powerful and sometimes transforming' (Segal, 1975). A 1968 US Senate report on LSD policy noted that all expert witnesses were opposed to criminalizing LSD use and concluded: 'The tardy reaction of the Government was rash and excessive, resulting in the termination of almost all research... As protector of the public safety and supporter to medical research, the Government had an obligation to maintain a balanced perspective concerning LSD at a time of public tumult. It failed to do so' (US Senate Committee on Government Operations, Subcommittee on Executive Reorganization, 1968). LSD, psilocybin, mescaline and several other psychedelics are included in Schedule I of the US Controlled Substances Act of 1970; these substances were simply placed in Schedule I by Congress without an evidence-based assessment to determine whether LSD and other psychedelics met criteria to be added to Schedule I. There may have been a political rather than public health rationale behind the criminalization of psychedelic users. It is deeply troubling to read an interview with John Ehrlichman, advisor to US President Richard Nixon, in which he explains that the War on Drugs was 'really about' hurting 'the antiwar Left, and black people', and openly admits, 'Did we know we were lying about the drugs? Of course we did' (Baum, 2012).

Conclusions

The results of this study are consistent with our previous population study, early and recent randomized controlled trials, studies of regular participants in legally recognized psychedelic religious ceremonies, drug education materials from public agencies and recent expert assessments of drug harms (Krebs and Johansen, 2013b). There is little evidence linking psychedelic use to lasting

mental health problems. In general, use of psychedelics does not appear to be particularly dangerous when compared to other activities considered to have acceptable safety. It is important to take a statistical perspective to risk, rather than focusing on case reports and anecdotes: 'Nothing in life is free from risk – risk is simply impossible to avoid... Even ordinary activities – eating breakfast, watching television, walking the dog – carry risks, however minor' (BMA, 2012). As Steven Pinker recently noted, 'In a free society, one cannot empower the government to outlaw any behavior that offends someone just because the offender can pull a hypothetical future injury out of the air' (Pinker, 2008). Overall, it is difficult to see how prohibition of psychedelics can be justified from a public health or human rights perspective.

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